# Making Fortran programs for solving Burgers' equation using Godunov's and Kurganov- Tadmor methods

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# Contents

# 1 Writing Fortran code

We write a Fortran program that solves Burgers' equation. Instructions for compiling and running the program are located in the README.md file that comes with the source code.

# 2 Plotting solutions for sine initial conditions

We calculate solutions to Burgers' equation calculated using Godunov's and Kurganov-Tadmor's methods. We use one hundred $x$ points, Courant factor of 0.5 and sine initial conditions. The plots of the solutions are shown on Figures 1, 2 and 3 for time values of $t = 0, 0.5, 1$ $s$.

A movie of the solution is available here:

`https://youtu.be/Pp4WZkqskdg`

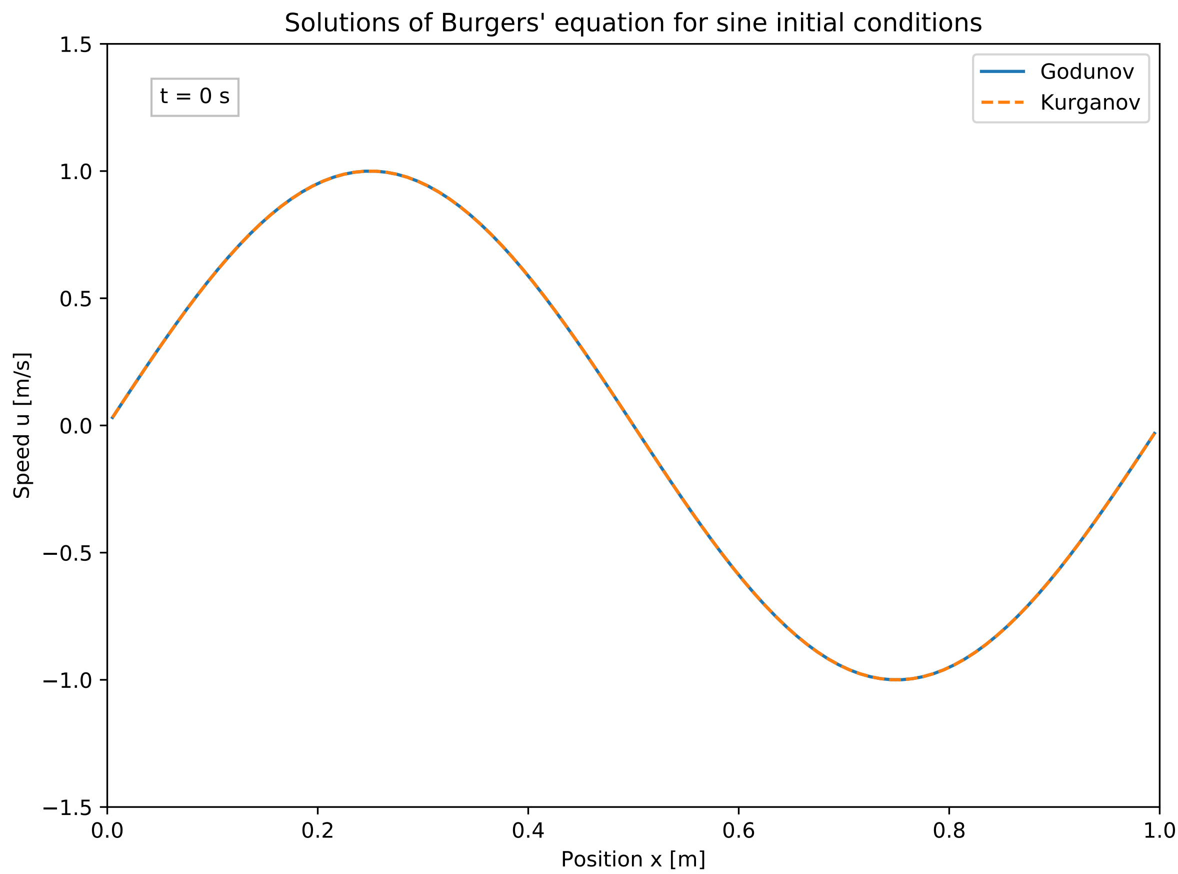


Figure 1: Solutions of Burgers' equation with sine initial conditions at $t = 0$ $s$.

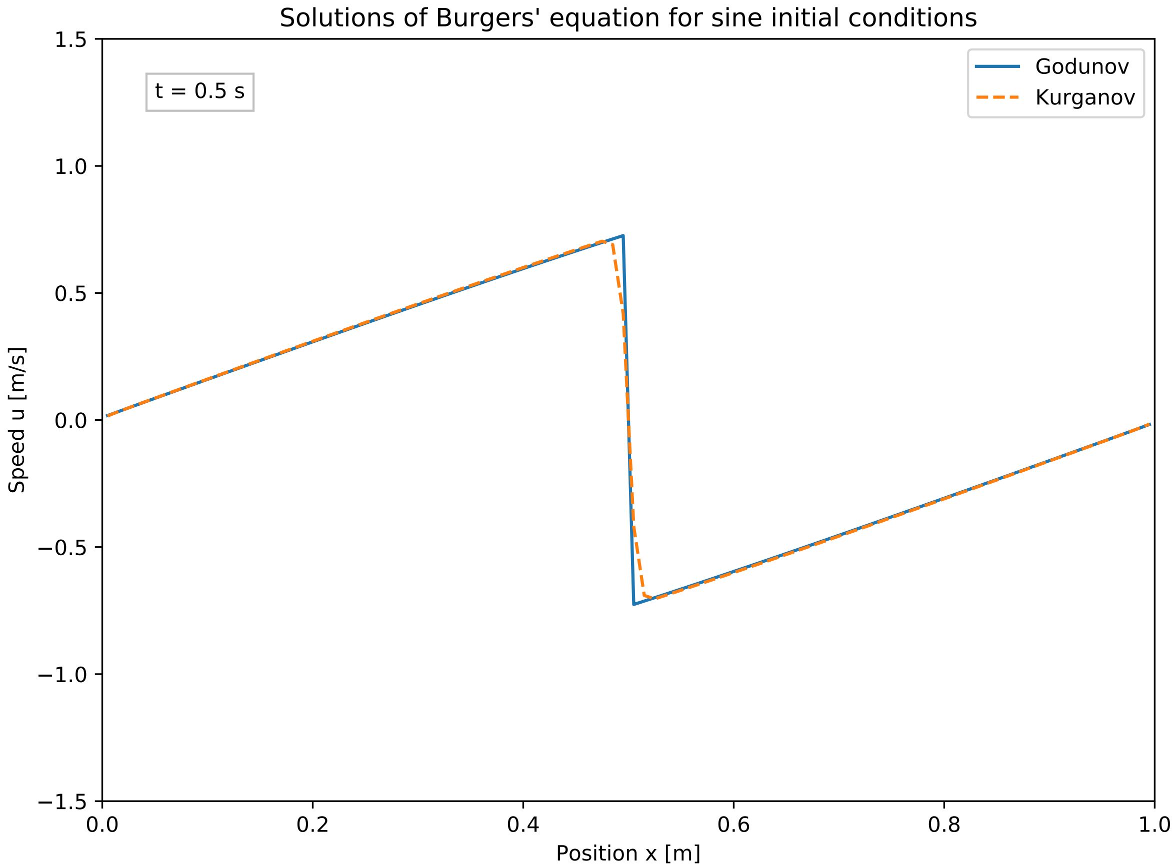


Figure 2: Solutions of Burgers' equation with sine initial conditions at $t = 0.5$ $s$.

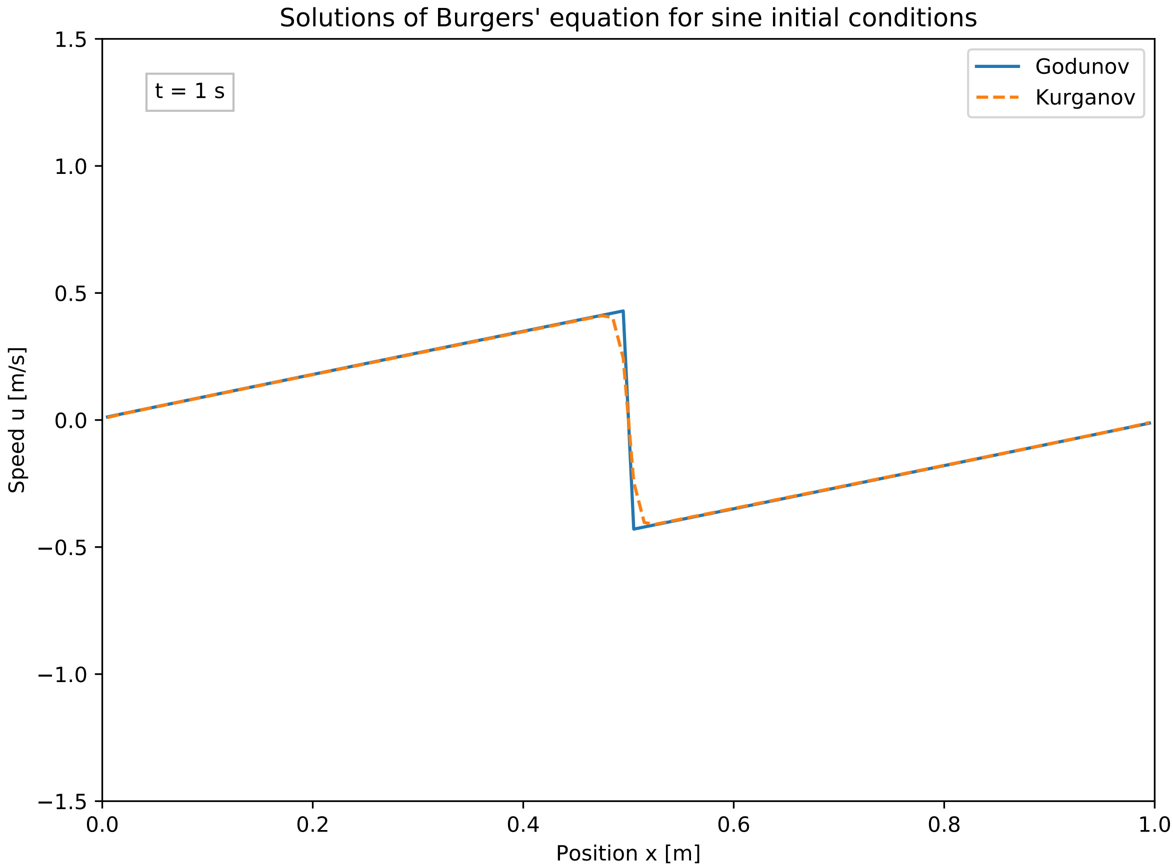


Figure 3: Solutions of Burgers' equation with sine initial conditions at $t = 1.0\ s$.

# 3 Bonus: plotting solutions for square initial conditions

Next, we solve Burgers' equation, starting with square initial conditions, using the same parameters as before. The plots of the solutions are shown on Figures 4, 5 and 6

A movie of the solution is available here:

`https://youtu.be/oekOnANB0D0`

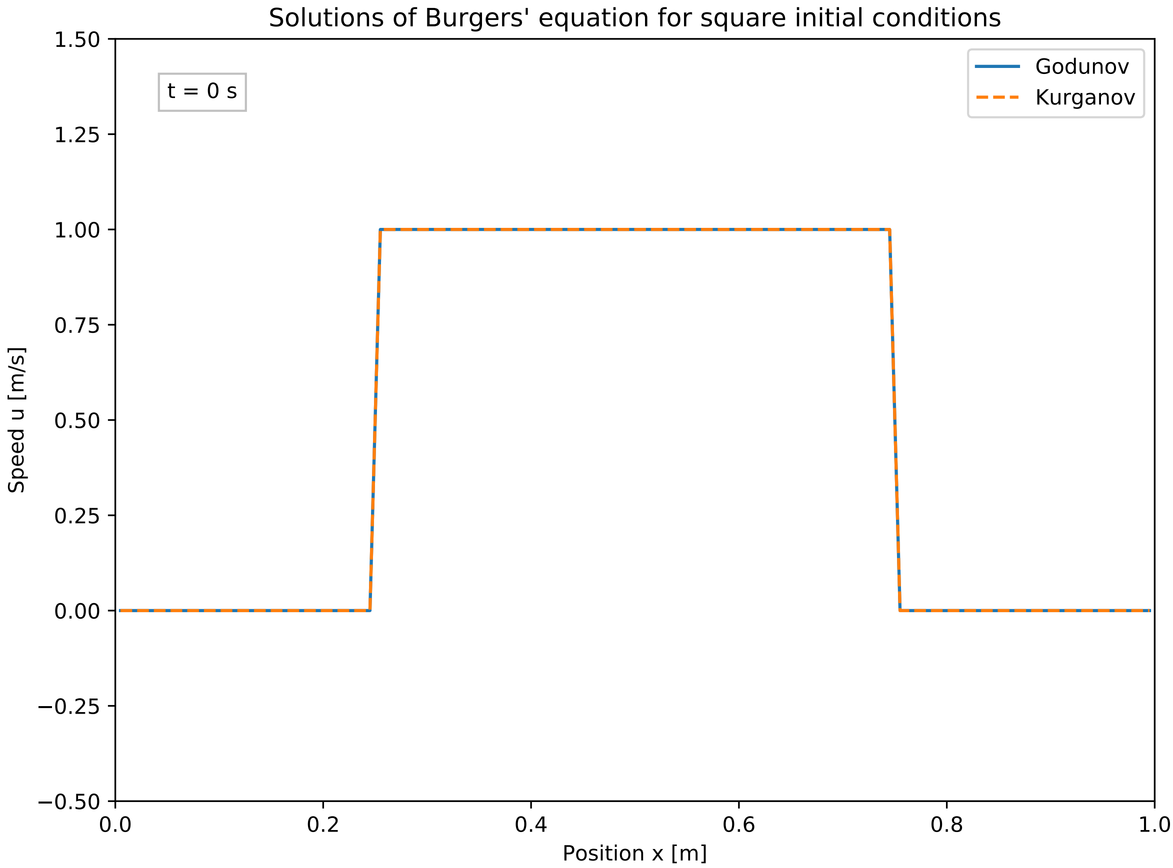


Figure 4: Solutions of Burgers' equation with square initial conditions at $t = 0\ s$.

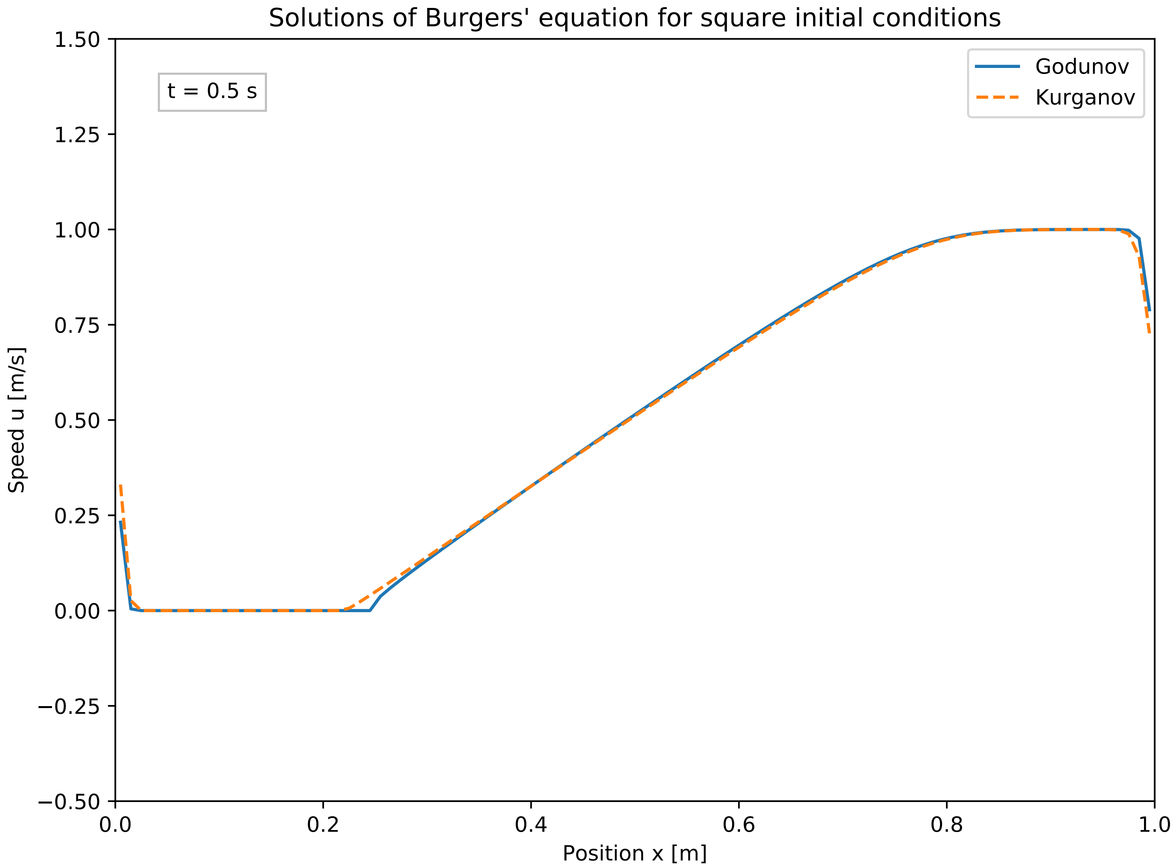


Figure 5: Solutions of Burgers' equation with square initial conditions at $t = 0.5\ s$.

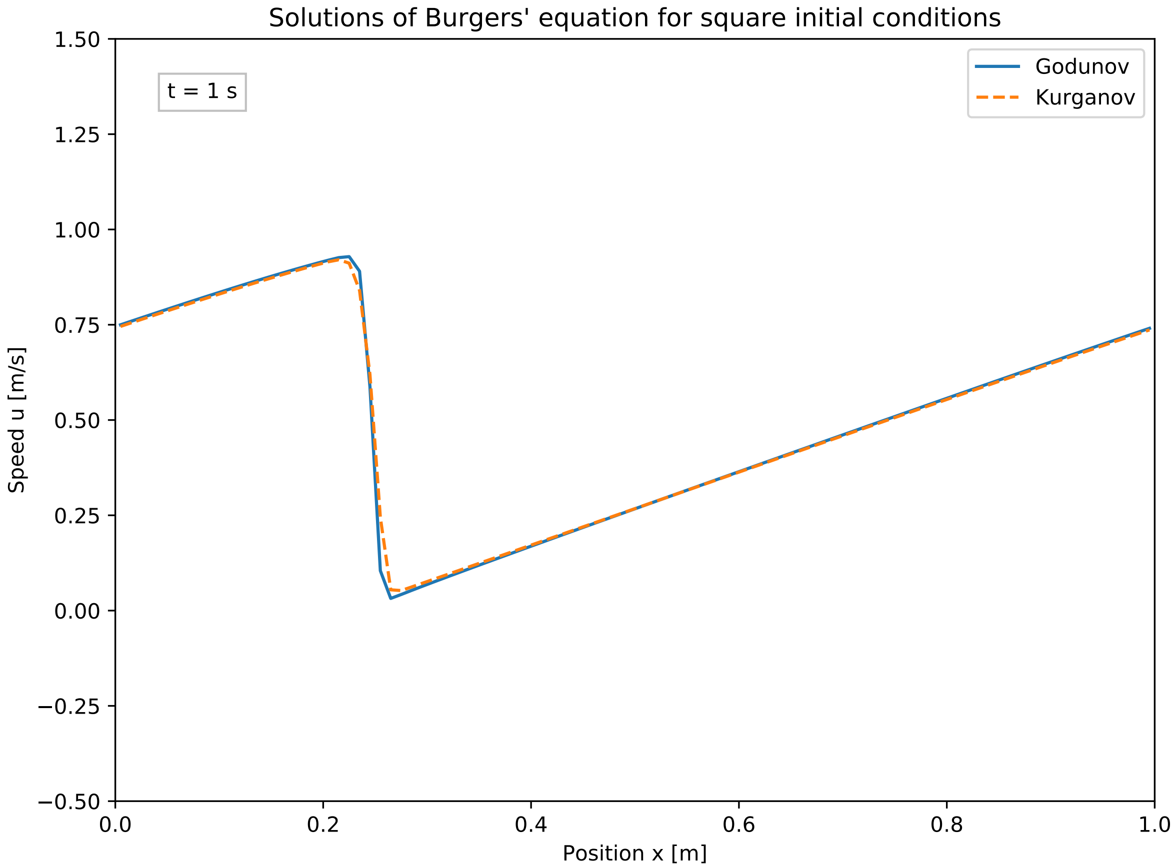


Figure 6: Solutions of Burgers' equation with square initial conditions at $t = 1.0$ $s$.

# 4 Analyzing results

It can be seen from Figures 3 and 6 that Burgers' and Kurganov-Tadmor's solution appear to agree for most values of the domain. However, the two methods are slightly different in shock regions – at values of $x$ where velocity is changing rapidly. In these regions Kurganov-Tadmor's solution is more smooth than Godunov's.